. . . for land's sake!

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David M. Welch

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Preface

This book is about Land. It's about our land, how we use it, and what we, as Canadians, can do to use it wisely, both now and in the future. The full story of our land and all its uses cannot be told in one book. Instead, we can glimpse Canada's natural history and environment, our land uses and the condition of our land resources. Views of the future can also be projected. We hope to communicate an appreciation for one of our great resources through a common-sense understanding of our environment, its use, related issues and problems as well as the techniques now being used or being developed to solve these problems. Appreciation is one of the first steps in achieving a responsible attitude towards land resources. In a society which cares more and more about its environment, we must develop a "land sense" not only for our own benefit, but . . . for Land's Sake!

Acknowledgements

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Tom Pierce and Cathy Normandin assisted greatly in the selection and procurement of illustrations. Design concept was provided by B.B. & H. Graphics, and Environment Canada Information Services Directorate steered the book through production phases.

How to Make the Most Use of this Book

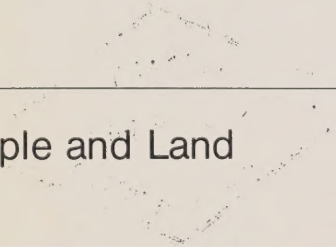
This book is not for reading only! Consider instead the variety of Canadian land, the land-related problems and the proposals. This book can stimulate discussion on and concern for land issues. For example, do you know the views of local aldermen and policitians on land-related issues, zoning or land use policies within your area? To what extent do you think that land resources and environmental quality should be considered in local, regional, provincial or national planning?

This book is in three parts with a number of topics in each. As you read through, however, you will see how all the topics relate to each other. This is another one of our goals, to show how land-related issues can no longer be ignored or tackled piecemeal.

Pages

6–19 The Natural Environment

To understand the problems and issues relating to land in Canada it is necessary to understand the shape or form of the land, the processes responsible for the present landscape, its soils, plants and animals. The different characters of Canada's land, from region to region, and the interaction of various physical elements which have produced the diverse resources of the nation are considered in the first section.



20–33 People and Land

This section discusses the human history of Canada — including the native people, immigration, rural settlement and the development of cities, to present land uses and abuses.

34–46 Land for the Future

This section describes some options which can ensure rational and effective use of our land in the future. It addresses the possible roles of individuals and governments in carrying out the options, and indicates sources of information which may be useful in solving land problems.

Most topics include further readings. In most instances, these are available through libraries or by writing to the:

Canadian Government Publishing Centre
Supply and Services Canada,
Hull, Quebec, Canada, K1A 0S9

For further information about references or topics mentioned in this book, please contact:

Information Services Directorate,
Environment Canada,
Ottawa, K1A 0E7, Canada.

The Shape of Our Land

The science which unites geology and topography, and which describes and explains the broad shapes of the earth's surface, is called physiography. Canada has six major physiographic regions, each with a characteristic pattern of rocks and relief, and each with a distinctive influence upon regional land uses. The major physiographic regions of Canada are:

Western Cordillera

Hills and high mountains are common here. Much of the land is too steep for cultivation, but its soils are fertile for forestry and its relief provides excellent scenery for the tourist. For the renowned forest industries of British Columbia, however, the rough terrain can present problems such as movement of equipment and risks of erosion.

Interior Plains

This is undulating land on gently-folded sedimentary rocks. Underground, the folded rocks store large amounts of oil, gas, coal and potash. Where climate permits, the land surface is excellent for ranching and cultivation; the terrain is ideally suited to modern farming machinery.

Canadian Shield

These ancient, worn-down rocks produce little soil and agriculture is rare. Instead, the land is suitable for forestry, mineral extraction and hunting and sportfishing on the countless lakes of the shield, as well as other forms of recreation.

St. Lawrence Lowlands

Physiographically, this area resembles the Interior Plains, but is without significant quantities of fossil fuels. It does contain excellent agricultural land. The St. Lawrence River and the Great Lakes have traditionally served as a transport corridor for this area and leading to the Canadian west.

Atlantic Region

A geologically older version of the Western Cordillera, its mountains have been subdued by erosion. Relief and climate frequently limit agriculture, although the rocks do yield coal and iron ore. This same physiography, however, provides excellent scenery, and there are many picturesque ports and deep-water harbors.

Inuitian Mountains

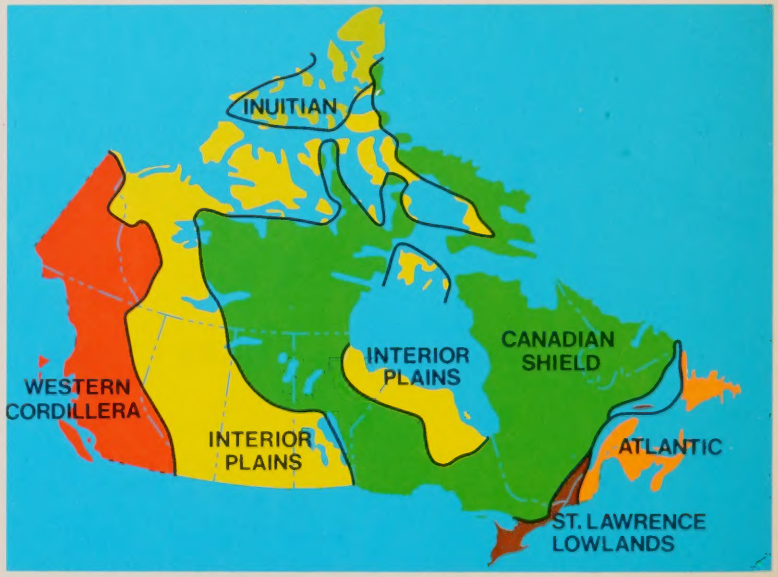
These are the physiographic kin of the Atlantic Region. The polar location, however, means that they are barren, ice-capped and unpopulated lands.

Question: As a compromise between construction costs and scenic attraction, what physiography do you consider best for urban development?

Further reading: Douglas, R.J.W. (Editor), 1970, Geology and Economic Minerals of Canada. Supply and Services Canada, 838p

National Film Board

Two landscapes of contrasting physiography; snow-capped, forested mountains and flat, agricultural lowlands. The Fraser River Valley, British Columbia.



THE PRINCIPAL PHYSIOGRAPHIC REGIONS OF CANADA

From Glaciers to Gumbo

Canada was covered by ice at least four times during the past million years. These glaciers eroded soils and less-resistant rocks; the resulting debris is now deposited over large areas of the Interior Plains and St. Lawrence Lowlands. Ice, unlike rivers, is not confined to valleys and it can also move almost any size of debris. Consequently, large volumes of debris were left behind as melting decreased the extent of ice sheets. These deposits form an undulating, usually fertile, well-drained sediment, but one which often contains many stones.

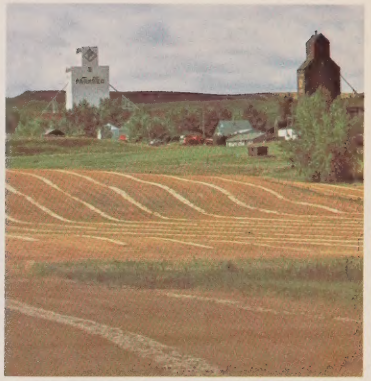
Where glacial meltwater was ponded into lakes, finer particles were often carried away from larger ones, eventually forming extensive, poorly-drained but fertile plains such as those around Winnipeg, Regina and Edmonton. These soils are known locally as gumbo.

By contrast, the erosion-resistant rocks of the Canadian Shield yielded little debris to glaciers. Even now, several thousand years after the last glaciers, they are only thinly covered by soil, and are generally unsuitable for agriculture.

Apart from obvious implications for agriculture, the ice ages also bequeathed such features as deep valleys cut by meltwater, and deltas and beaches around glacial lakes. These were often the sites where sand and gravel were deposited, so that today, the search for materials for the construction industry is closely tied to our understanding of former glaciers.

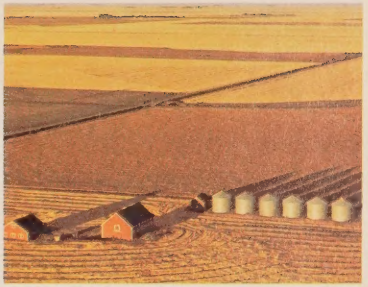
David Welch

The Canadian Shield, a land of rocky hills, lakes and many forests and wetlands. Eastern Quebec.



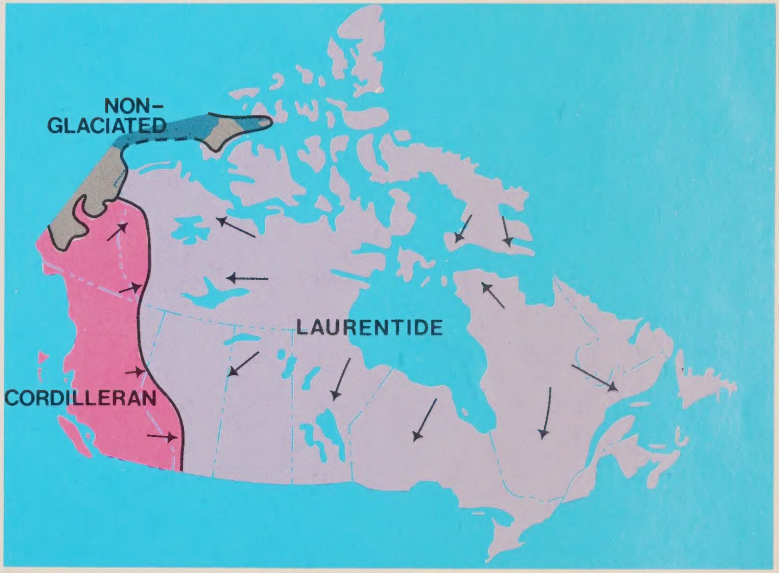
National Film Board

As the glaciers retreated, they left behind many rolling plains like this one in Saskatchewan.



National Film Board

Melting glaciers often resulted in large lakes. The beds of these lakes now yield flat, extensive plains of prime farmland. Saskatchewan.



THE PRINCIPAL FORMER ICE SHEETS OF CANADA

Question: Approximately how many years ago did the glaciers retreat?

a) hundreds of years
b) thousands of years
c) hundreds of thousands years

Further reading: Bird, J.B., 1972, The Landscapes of Canada. Wiley, 191p.

Land Forming Processes Today

To our eyes, physical evolution of landscape seems exceedingly slow. Averaged across the continent, this is indeed true. Each year, erosion strips Canada of approximately 0.03 millimetres of soil. At any given time, however, this average change is concentrated into small areas, on hillslopes, riverbanks and shorelines, for example.

A hillslope may be stable for decades, and yet collapse in a catastrophic mudslide lasting only minutes. A normally placid river can overflow, leaving may centimetres of silt on its floodplain. Although not an everyday risk to most Canadians, nevertheless, we should recognize the portents of natural hazards before our basements settle and crack, our houses fill with water, or the approach to a boat dock fills with silt.

It is difficult to specify the rate of erosion or deposition on a given parcel of land. Steepness, vegetation, soil type, rainfall intensity, variations in water level and disturbance by man are all related factors. One good rule of thumb is that landscape processes rarely occur in isolation. For example, if your neighbor's land shows signs of a recent landslide, flood, or whatever, there is a strong chance that sooner or later your land will suffer the same fate.

Running water, on slopes or in rivers, is not nature's only tool as she molds the land. Glaciers, wind, waves and currents all play a role. These processes are less common, however, and they rarely trouble us. To the contrary, ice, sand dunes, beaches, cliffs and caves are valuable resources for our pleasure. Where man errs it is to forget their dynamism by trying to preserve rather than protect such features, as though they were fossils. The grandeur of cliffs is born of the relentless action of waves. Beaches and dunes maintain their golden sands only by the continued movement of sediment from nearby sources such as eroding cliffs.

David Welch

Rivers often erode the outside of their bends and deposit on the inside. Rivière St. Jean, eastern Quebec.

David Welch

Steep slopes and clay soils can be disastrous to the homeowner. Near Winnipeg.

David Welch

When sand is moved by wind, the results can be visually attractive and provide opportunities for recreation. Southwest Manitoba.

Canada Land Inventory

Erosion by waves can produce spectacular features. Fundy National Park, New Brunswick.

Question: When natural disasters strike at property and lives, who, if anyone, should be required to pay for remedial measures?

Further illustrations: Blackadar, R.G. and L.E. Vincent, 1976, Focus on Canadian Landscapes. Supply and Services Canada, 178p. This is a pictorial essay on landforms and rock formations in Canada.

Opposite page: A dry climate but with infrequent, heavy rains has produced the badlands of southeast Alberta.

Canada Land Inventory

Canada's Climate: Coastal, Continental and Cold

Canada is a land of climatic extremes, so much so that climate exerts as much influence on regional land use as does physiography. Canada is situated in a zone of westerly air flows. These air masses, moving in from the Pacific, would spread rain or snow all across the country were it not for the barrier effect of the Western Cordillera. Instead, air from the Arctic, the Gulf of Mexico and the Atlantic is as common over the Plains, the Shield and eastern Canada as is Pacific air.

Day-to-day weather patterns are controlled by the presence of one or more air masses and by disturbances moving along their boundaries. The seasons change with north/south shifts in the movement of the respective air flows and, of course, with the changes of sun angle and length of daylight.

Added to these factors is continentality, the effect of greater summer heating and greater winter cooling over land than over water. Thus, temperature extremes are greater in the continental interior than in coastal regions.

THE CLIMATE REGIONS OF CANADA

Climate Regions of Canada

Arctic

High latitudes and low sun angles account for a cold climate. The influence of oceans, however, maintains winter temperatures generally above those of the Northern climate region. On a year-round basis much of the Arctic is dry enough to be classed as semi-desert.

Northern

Continentality makes this region the coldest in winter, but often as warm as the prairies and southern region in summer. In the east of this region, storms from the Atlantic bring more snowfall than to any other region in Canada.

Prairie

The Prairie region is a continental interior where hot summers combine with physiography, resulting in one of the world's prime grain producing areas. In southern Alberta, however, frequent irrigation of crops is required because of dry summers. Despite little snow and rainfall throughout the region, rapid spring thaws can produce disastrous floods.

Southern

A southerly latitude and the movement of air from the Gulf of Mexico and the Atlantic Ocean give the region relatively mild winters and hot summers. These air masses of maritime origin, plus the contribution of moisture from the Great Lakes, yield high year-round precipitation.

Atlantic

This climate is similar to the Southern region, but with cooler summers and stronger winds, especially in winter. These trends are the result of the Atlantic Ocean's influence on air masses.

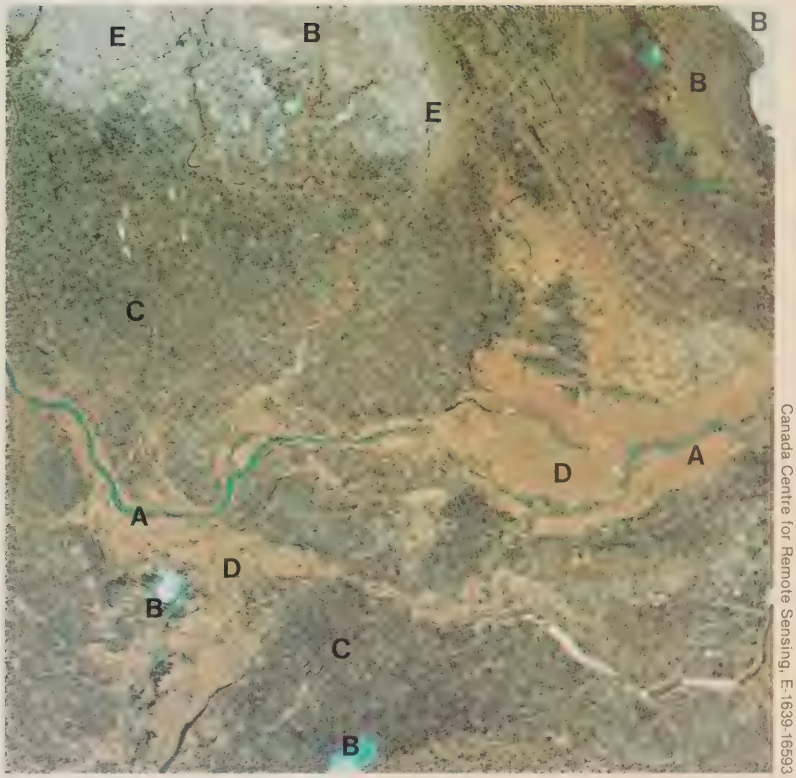
Pacific

Like the Atlantic region, this narrow strip of land has a maritime climate. Here, however, precipitation is further increased by coastal mountains which force the lifting and cooling of damp air. This area has the country's highest rainfall, the main factor responsible for the highly productive forests of western British Columbia.

Cordilleran

Complex physiography produces a complex climate. High rainfall uplands are interspersed with dry, hot valleys. This pattern results when air moves up-slope, cools, and then loses moisture. On descending into the next lowland, it contains less water and therefore warms up faster. Orchards and vineyards thrive here, although irrigation is often needed.

Right: This satellite view, dated 23 April 1974, of southwest Manitoba shows several effects of a spring thaw. Sinuous green areas mark flooded river valleys (A). Most lakes are still ice-covered and appear white to blue (B). Fields are still bare but damp; they appear dark brown (C). Sand deposits are dry and appear light brown (D). To the north, the higher ground of Riding Mountain National Park still has its snow cover (E).



Canada Centre for Remote Sensing, E-1639-16593

Below: A flooded river seen close-up. Our climate can affect us quite strongly. Saskatchewan.

National Film Board

Question: Bearing in mind the world-wide relationships between climate, agriculture, population density and lifestyle, what would you consider to be an ideal climate?

Further reading: Hare, F.K. and M.K. Thomas, 1976, Climate Canada. Wiley, 256p.

Soils: The Thin Skin of Canada

Without soil to sustain food crops or animals' forage, we would soon face hunger. The trees which provide us with paper and lumber would also be lost. Soil is naturally-occurring mineral or organic material on the surface of the earth which is capable of supporting plant growth. Soil is formed by combining physical, chemical and biological processes to alter the surface material left by geologic and land-forming processes. Some processes break down the surface materials; others give rise to substances not originally present. These substances may become concentrated, such as when salts, carbonates, iron or aluminum migrate into distinct soil layers.

The nature of soil depends on many factors. The rate of rock breakdown, the upward and downward movement of moisture and minerals, and plant cover and humus all depend on climate. Elevation and slope modify climate on a local scale. Drainage, itself dependent on precipitation, slope, soil texture and on the presence of nearby lakes or streams, determines the water content of soils and thereby most chemical activity. Surface material determines texture (e.g. stoniness) and the initial fertility of the soil.

These processes and factors require thousands of years to create well-developed soils. Because Canada has been recently glaciated, and because much of our land is frozen for large parts of the year, most of our soils have not had sufficient time to develop fully, and so remain thin or skeletal.

THE PRINCIPAL ZONES OF SOIL LIMITATIONS FOR AGRICULTURE IN CANADA

PREDOMINANTLY FROZEN GROUND

UNFROZEN, BUT WITH BEDROCK AT OR NEAR THE SURFACE

PRINCIPAL ZONES WITH SOIL POTENTIAL FOR AGRICULTURE

Land Resources Research Institute

Above: A chernozemic soil from southern Alberta. This shows a more uniform profile than the podzolic soil. Chernozems occur under moderately humid conditions on clay-rich soils.

Land Resources Research Institute

Left: A podzolic soil from northern Saskatchewan, showing the characteristic dark layer of leaf litter (above spade handle) leached layer (level with the handle), and a red-brown layer where leached materials accumulate. This profile results from excess downward seepage, usually on sandy materials.

The interaction of physical, chemical and biological processes and the soil-forming factors results in alteration of surface materials, and formation of layers, or horizons, known collectively as a soil profile and usually confined to the top 1.5 metres of soil. Soil horizons are differentiated by color, texture (e.g. fine-grained or coarse), structure (e.g. granular or blocky), consistency (e.g. crumbly or cemented) and composition (e.g. clay or quartz minerals, or elements such as sodium, calcium or nitrogen).

In a country as large as Canada, with its diversity of climate, vegetation, bedrock, surface materials and landforms, soil conditions give rise to vast and varied soil profiles. There are, however, some common features among these profiles. Most soils include three main horizons. The uppermost horizon consists of sub-layers of leaf mold, humus accumulation, and moisture and nutrients moving down. The second horizon is a layer where nutrients concentrate due to seepage from above. The lowest horizon is made up of partially-decomposed but unsorted material. When a soil is improperly used the top horizon, and even part of the second, may erode, resulting in a loss of layers which contain most of the organic and nutrient wealth of the soil upon which plant growth depends.

Although Canada is the world's second largest country, the area covered by soil capable of supporting sustained crop growth is limited. Nearly 56 percent of Canada has an environment capable of supporting only tundra or limited forest growth. Cold climates, permanently frozen ground, barren rock and ice caps restrict growth. About 32 percent of the land can support productive forest, but the environment is too harsh and the soil too poor to support agriculture.

Of the remaining 12 percent, about one-third has various limiting factors, such as low fertility, poor soil structure, stoniness, drought, flooding, or combinations of these. Only 7 percent, or 714 000 km^2, is suitable for field crops, primarily in central British Columbia, the Prairies, and the Great Lakes-St. Lawrence Lowlands.

Questions: What properties of soil would you consider ideal for crop growth? How does this "ideal" compare with the soils of your region?

Further reading: Clayton, J.S. et al, 1977, Soils of Canada. Supply and Services Canada, 2 Vols.

Canada's Plants

Why They Are Where They Are

The dominant vegetation of Canada varies greatly from south to north and from east to west. Variations are due largely to plants' adaptations to climate, fire and recent geological history.

From south to north, and from low to high altitude, climate progressively becomes more severe. Growing seasons are greatly reduced and dramatic changes in temperature are frequent. In northern latitudes, and at high elevations, plants must therefore be hardy to survive. Those that do succeed grow slowly.

About 45 percent of Canada has soils which are frozen all year round. This is permafrost, a mixture of soil and permanent ice. The roots of plants can grow only in the active layer of the permafrost, the upper layer of soil which thaws each summer. Thus the plants of permafrost areas are generally smaller compared to plants elsewhere.

The dry climates of the prairies and western boreal regions are prone to forest or grass fires. Typical plants in these areas are those which can reproduce by root suckers such as trembling aspen; by light, easily-transported seeds such as spruce; or cones which open to release seeds only after exposure to the heat of fire, such as jack pine.

Ed Wiken

Although mountainous, the Cordilleran plant region is noted for its forest.

Where there is more rain and a longer growing season, as in the deciduous forest region of southern Ontario, trees can grow taller and forests become more mixed. Typical trees in these areas are oak, hickory and walnut. These plants all depend on animals such as squirrels to spread their heavy seeds.

Recent geological history also plays a role in determining vegetation patterns. Site conditions for each plant are largely related to glaciation and its related landforms. The degree and direction of slope, drainage and soils explain the details of most plant distributions. In a broader context, when the ice receded about 10 000 years ago, the land was left bare of vegetation and often stripped of soil. The present distribution of plants in Canada partially reflects their ability to migrate and adapt to harsh climates and poorly-developed soil.

The Plant Regions of Canada

Based on the dominant plants within an area, the natural vegetation of Canada can be divided into several regions. Between all regions are transition zones of varying widths. These include species characteristic of the regions on either side of the transition.

Cordilleran Region

In mountain areas, changes of elevation bring dramatic changes in temperatures, precipitation and wind. In the Cordillera the patterns of vegetation are consequently very complex. Dense rain forest on the coast, open forest and grassland in the hot semi-arid interior valleys and high alpine meadows are common examples. Tree species include western red cedar, western hemlock, Douglas fir, lodgepole pine and Engelmann spruce.

Boreal Forest Region

This comprises the greater part of the forest area of Canada. It is dominated by needle-leaf trees, such as white spruce, black spruce, balsam fir, jack pine and tamarack (larch). White birch, balsam poplar and trembling aspen are common broad-leafed trees.

Tundra Region

Arctic tundra is treeless land in northern areas. Alpine tundra occurs above the upper tree line in mountainous areas. Sedges, dwarf shrubs, grass, moss and lichen are the most characteristic plants.

THE PLANT REGIONS OF CANADA

Prairies (Grasslands)

Here were once extensive tracts of land dominated by grasses and other herbaceous plants. Now there are mainly fields of crops or pasture. Trembling aspen groves are common around wet depressions. Other poplars, willows and white spruce are found along rivers.

Deciduous Forest Region

Although the smallest in area of the vegetation regions within Canada, it displays the greatest variety of tree species. For the most part the trees are deciduous, shedding their leaves annually. Maple, oak, beech, white elm, basswood, red ash and butternut dominate. Many others have exotic-sounding names, such as the tulip-tree, cucumber tree, pawpaw, sassafras and pignut hickory.

Great Lakes—St. Lawrence Forest Region

This region is partly a transitional area between the Deciduous and Boreal Forest regions, but it is also typified by species of its own, including eastern white pine, red pine, eastern hemlock and yellow birch. In the east the region incorporates red spruce, characteristic of maritime Canada.

Tom Pierce

Moss, lichen and stones of the tundra on Banks Island.

David Welch

Typical slow-growth spruce of the Boreal Forest region. East of Lake Winnipeg, Manitoba.

David Welch

Grasslands near Drumheller, Alberta.

National Film Board

Fall colors of the Great Lakes—St. Lawrence region. Gatineau Park, Quebec.

Question: Why is it sometimes more useful to leave a forest as it is, rather than to cut it for lumber or pulp?

Further reading: Rowe, J.S., 1972. Forest Regions of Canada. Supply and Services Canada. 273p.

Canada's Wildlife

Fauna needs Flora

Most plants produce their own food by the process of photosynthesis. They take water and nutrients from the soil and carbon dioxide from the air, and, with the aid of energy from the sun, produce sugars and starch for plant growth. Animals, however, are consumers, depending on plants for their food. Animals may be herbivores, feeding on plants, or predators, devouring other creatures. Even the predators depend ultimately on plants, since the animals which they eat are usually herbivores.

Making the Most of a Difficult Situation

Throughout most of Canada, many years passed between the last ice retreat and colonization by plants. Animals had to wait until plants spread into an area before they could move in to that area. Many of these creatures possessed, or developed, physical features which helped them to survive.

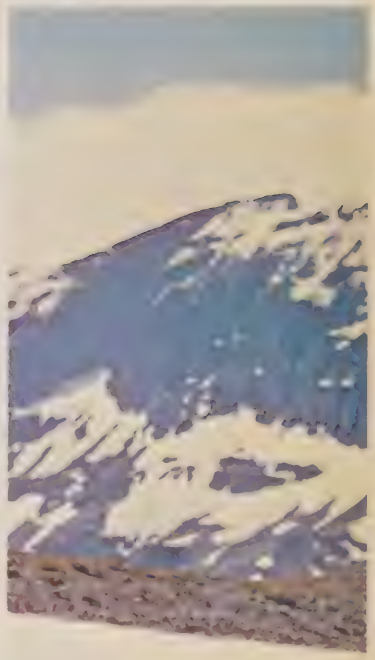
For example, moose are found in most of the forests of Canada. Their long legs enable them to travel easily through deep snow. Muskox and arctic fox have thick fur, providing them with comfort even at -50°C. The fur of some animals is also camouflage; the arctic fox and shorttail weasel, both of which grow white fur for the winter, are able to profit from their coloring when stalking unwary prey.

Alberta Public Affairs Bureau

Moose favor areas with access to water and marsh plants.

The snowshoe hare also grows white fur for the winter, enabling it to hide from predators. Because of this color change, it is often called the varying hare. The snowshoe hare derives its name from another adaptation to Canada's climate. Its large hind feed act as snowshoes, preventing it from sinking too far into the snow as it travels.

Other animals have adapted to our climate by avoiding cold. Most birds (and many people) migrate south for the winter. Some mammals, such as the woodchuck, hibernate, a state in which respiration rate and body temperature are greatly lowered to reduce energy expenditure. Other animals simply sleep in dens, living off food stored from the previous summer, as do chipmuks, or on reserves of body fat, as do most bears. Other creatures become dormant or inactive, such as frogs and insects.



David Welch

Mountain goats on alpine tundra.

Tom Pierce

Polar bears inhabit ice floes and shorelines.

Force of Habitat

Many factors combine to determine which animals can live in an area. Each has different needs based on where they prefer to live, whether in water, in or on the ground, or in trees, and their requirements for heat, food and liquid. The habitat of a particular animal is the sum total of all conditions which make a place suitable.

Food must be available and for many animals the habitat must provide shelter from predators and climate. What is suitable habitat in one season may be unsuitable in another. As a result many animals migrate. Each year caribou travel hundreds of kilometres from their calving grounds and summer range on the arctic tundra to their winter ranges in the forests south of the tundra, returning north the following spring. Canada geese travel thousands of kilometres from their wintering grounds to their summer nesting areas. From the southern United States they journey to all parts of Canada except the high Arctic. Nests are often built near woody vegetation, usually on islands or islets and within a few metres of water.

Most animals must accept the land as it is. The beaver, however, changes conditions to suit its needs. It builds a dam to create a pond, used to store its winter food supply. The water must be deep enough so that the pond does not freeze to the bottom during winter. Most of the sticks and twigs of the beaver's food cache extend below the ice. An underwater exit from the lodge permits year-round access to the food supply.

Canadian Wildlife Service

Geese and other waterfowl depend on wetlands for survival.

Question: In the light of the many extinctions evidenced throughout geologic history, should mankind safeguard all wildlife species? If so, how should this be done?

Further reading: Hinterland Who's Who, a series of free pamphlets on Canada's native animals, published and distributed by the Canadian Wildlife Service, Environment Canada.

Ecosystems: Combining the Elements

When we think of Canadian artists, our thoughts often turn to three K's, Krieghoff, Kane and Kurelek, to Emily Carr, and, of course, to Tom Thomson and the Group of Seven. All of these artists specialized in landscapes, or people in the context of their land. While their individual efforts portray particular regional landscapes, such as the west coast rain forests of Carr, the Arctic of Harris and central Ontario of Thomson, collectively they depict the diversity of the Canadian environment. Equally, however, each work reflects a scene in its related parts, the mountains, streams, trees, clouds and, sometimes, man. While locations may change, these elements often recur over large areas.

So far, we have looked at physiography, landforms, climate, soils, plants and wildlife as separate topics. Many of the examples, however, hint at relationships among these factors. From the many combinations possible, certain ecosystems have developed. These ecosystems are landscapes with definite limits on the earth's surface. The largest ecosystems are the most apparent, such as rolling tundra in the north, temperate rain forest on steep slopes in western British Columbia, the prairie grasslands, or the complex of rocky hills, boreal forest, wetlands and lakes that cover most of the Canadian Shield. We see portions of these ecosystems represented in the work of many Canadian artists.

Each ecosystem conveys a particular location and combination of factors. For instance, the prairie grasslands are mainly associated with southern Alberta and Saskatchewan, and with environments of treeless plains, fertile and humus-rich soils, warm and dry summers, and animals such as the pronghorn antelope, prairie dog and prairie chicken. Collectively, these traits differ from those of the temperate rain forest, of the Pacific coast, or the tundra of the Canadian north. These ecosystems occupy large tracts of land. In contrast, there are smaller ecosystems, often interspersed throughout the larger ones — alpine pastures, prairie potholes and marshes are examples.

An ecosystem represents a state of balance among its components, which, barring major disruptions, endures as a self-maintaining entity for prolonged periods. This means that ecosystems can be identified and used for planning and management. Once information has been gathered on the different ecosystems of an area, the value of their respective properties can be determined.

Many components of ecosystems constitute natural resources. Examples are soil and its capability for producing crops; trees for timber, fuel or paper; wildlife habitat for hunting or conservation; and sand and gravel for construction. Our knowledge of an ecosystem helps us to predict the effects of human activities. We can ensure that harmful influences are avoided or alleviated, or that major alterations will not produce an undesirable environment.

Question: The fact that we live within certain landscapes means, automatically, that they are not fully natural. What are some of the man-induced changes in your region?

Further reading: Ecotours, a series of free pamphlets describing landscape ecology along sections of the Trans-Canada Highway, published and distributed by Canadian Forestry Service, Environment Canada.

Opposite page: Franklin Carmichael, Canadian, 1890-1945. Bay of Islands, 1930, water color on paper. 44.5 cm x 54.6 cm. Art Gallery of Ontario, Toronto. Gift from the Friends of Canadian Art Fund, 1930.

Native Peoples

Immigration to Canada began about 40 000 years ago, when Asians filtered southward through the American continent. The intervening millenia have seen a succession of cultures. In addition, various natural environments imposed limitations or opportunities for cultural and economic activities so that there can be no all-encompassing description of all their life-styles or uses of the land. Instead, we can only generalize.

One factor is common: native people were mostly hunters of mammals. In the south and boreal areas the Indians frequently hunted mammoth, bison or beaver. In the Arctic, the Inuit sought caribou, seals and whales. Despite being essentially meat-eaters, they maintained a balanced nutrition by using most parts of animals as food and even, in some cases, eating it raw. Fresh blood, for example, is rich in vitamin C and provides a good broth for cooking; scurvy was unkown to these people. In certain areas, natives supplemented their diet with roots or berries. In others, fish was the staple diet. Iroquois cultivated corn in southeastern Canada, as long as 3 000 years ago.

Hunting methods were diverse. Fire, stalking, fences, pitfalls, cliffs, ice holes — all were used to herd and kill animals. Weapons included the arrow, spear, harpoon and bolas. Once killed, the animal provided more than food. Clothing and tents from furs and skins, tools and weapons from bone, thread from sinew, heat and light from oil and fat, and ornaments from ivory and bone were common to most cultures.

The abundance of wildlife, particularly in northern Canada, is strongly seasonal. Migrations, prolonged sleep and hibernation contribute to the availability and whereabouts of animals. Because of this, native people were often nomadic or wide-ranging within large territories. Most individuals had intimate knowledge of an area stretching over hundreds of kilometres. Certainly these self-sufficient life-styles could not have been practised within the limits of most of today's reserves; a larger territory is required.

Depending on wildlife over thousands of years, native people developed religions, mythologies and cultures closely allied to the animal world. It appears that even before the eleventh century, native people had established a kind of pact with their animal-gods. As long as men killed only for need, their gods would ensure the tribe's safety and security. This belief, coupled with primitive tools, resulted in a harvesting of animals in balance with their reproductive rate.

This picture of man in harmony with nature does not coincide with evidence from more recent times. Evidence shows that before the sixteenth and seventeenth centuries, mammoth and mastodon became extinct, and the horse, camel, ground sloth and llama, once native to North America, died out until some were reintroduced by settlers. Historical evidence shows that explorers and fur traders found the native people eager to trap animals, not for subsistence, but in exchange for imported goods such as muskets and metal knives. Nineteenth century paintings and engravings show Indians driving vast herds of bison over cliffs, a practice which helped bring the bison close to extinction.

One explanation for this apparent conflict with nature is that native

people had no resistance to diseases endemic elsewhere. Viking fishermen probably introduced smallpox to North America, and natives died in large numbers during the ensuing centuries. It is believed that some natives felt that they had lost the protection of their gods, and retaliated by wreaking havoc on animals. Whatever the explanation, it seems that from the 11th to 17th centuries North Americans no longer lived in "peaceful harmony" with nature.

A similar case can be made for early man's relationship to plants. Many explorers of Canada described large-scale fires sweeping across the prairies and through boreal forest. Although lightning obviously played a role, many of these fires were accidentally or deliberately set from campfires, signal fires, fires used for herding game, and the like. Whatever their origins, Indians generally benefitted. Within the Boreal Forest Region, burnt-over areas improve conditions for young tree growth and provide better conditions for hunting deer. The clearings permitted easier hunting and travel, and also offered some margin of security to villages. Sometimes, however, the removal of vegetation by fire led to dust storms as bad as any of the 1930s Dust Bowl.

These observations provide us with several lessons. First, man is a geologically and biologically recent arrival in Canada. Secondly, native people did not always live in the idealized, ecologically-balanced state often attributed to them. Thirdly, we also see that adverse effects on the environment are not restricted to industrial societies. We may simply be the first era of man to consciously tackle problems of land use, conservation, pollution and finite resources.

Question: In view of factors discussed here, what is your idea of a "natural landscape"?

Further reading: Jenness, D., 1960, The Indians of Canada. National Museum of Canada, Ottawa, 452p.

Thomas, W.L., 1956, Man's Role in Changing the Face of the Earth. University of Chicago Press, 1193p.

National Film Board

To Canada's indigenous people, the cold winters meant good travel; the other months were often "bad going" to these hunters and trappers.

A Flood of Farmers: Immigration and Settlement

Patterns of Canadian settlement and farming have their origins in emigration from Europe where, in the 1700s and 1800s, land ownership was the privilege of a select few. As agricultural and industrial revolutions turned laborers away from the land, many were attracted to the cheap and plentiful spaces of the New World. Despite environmental limitations, land use and settlement patterns were based on the settlers' cultures, experiences and perceptions of land.

The unifying theme of Canadian settlement is transportation routes. In Lower and Upper Canada, early settlements were along rivers and lakes. In the 1700s, many French settled in southern Québec, and French, Scots and Irish in the Maritimes. By the early 1800s, the English inhabited the lower Great Lakes region and Vancouver Island. Transportation began to mean railroads by the mid 1800s. It was along these routes that people of many cultures pushed west during the later 1800s and early 1900s.

Early settlers chose land, and decided how to use it, according to their perceptions about land. One example is the "trees and land" theory. European experience taught that trees grew on good land, and that none grew on poor. In southern Ontario this theory held. However, on the prairie grasslands, there were no trees; the land was considered of no value and bypassed by many. These perceptions helped to delay development of agriculture in the west for several decades.

The first waves of settlers also established today's patterns of land ownership. The French introduced long, narrow lots; rectangular fields came with the English. Field sizes were based on arbitrary divisions of miles, or the work capacity of men and horses. The woodlot, for example, is a cultural heirloom, dating from when settlers maintained their own game, lumber and fuel supplies.

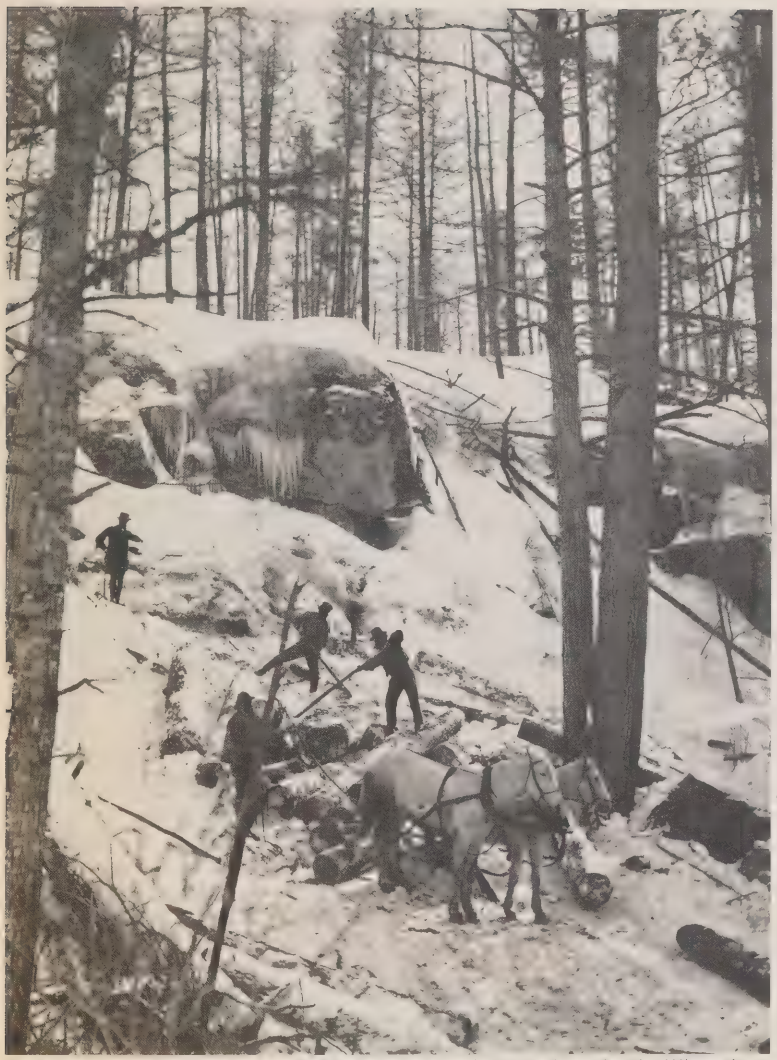
Productivity and land use were also restricted by the level of technology and the need to clear forests. Activities were labor-intensive and demanded the efforts of all members of the family. Thus was born our tradition of the family farm. Modern farming, in contrast, requires less labor per hectare. Furthermore, farm incomes today are relatively low compared to other professions and a farmer's children see more opportunity elsewhere. Many family farms are now sold or subdivided, while others are amalgamated into corporate farms where their larger size is more efficient as far as labor, mechanization and productivity are concerned. From 1931 to 1976 farm population decreased from 3¼ million to a million.

The amount of land used for agriculture is a result of economic and environmental factors. In the warm weather and cold economic climate of the 1930s, additional land was brought into production but much of this was poor land within good agricultural areas, or along northern limits of agriculture on the prairies. The marginal farms in the Maritimes and prairies are a legacy of that period. Much of this land is now abandoned, and could be put to better use than farming.

Questions: When was the land in your area first converted to agriculture? What are the main agricultural products of your area today?

RURAL LAND USES IN CANADA

- FIELD CROPS WITH SOME GRAZING
- MIXED FARMING AND FORAGE
- ROUGH GRAZING AND RANGELAND
- POTENTIALLY PRODUCTIVE FOREST
- OTHER FOREST
- ROCKLAND
- TUNDRA OR BARREN



Notman Photographic Archives, McCord Museum

Irish and Scots settlers were used to farming treeless, rocky uplands. When they came to Canada they often sought out such land in preference to more fertile soil. This scene shows land clearing in the Upper Ottawa valley, 1871.

National Air Photo Library, A 17526-14

Above: Long lots near Quebec City — the French connection.

Below: Rectangular road patterns and hedgerows near Sydenham, Ontario — the English influence.

National Air Photo Library, A 17775-106

The City and Industry

Canada Centre for Remote Sensing, RSA 30582 IR 9

This aerial view of Winnipeg shows many features typical of modern cities. Half a million people live in the area shown, measuring about 25 kilometers across.

A — Central Business District of offices, shops and institutions

B — Regular street patterns of pre World War II housing

C — Manufacturing and warehousing

D — Airport

E — Post 1950 subdivisions; crescents and curves

F — Parks

G — Golf courses

H — Railway yards

I — Farmland

The Functions of Cities

Cities, despite their obvious contrasts to the countryside, are a by-product of efficient food production. Ever since mankind developed agriculture, large numbers of people have been freed from the need to produce their own food and have developed other trades. These non-farming people usually settled in cities and towns. This clustering of people reduced day-to-day transport costs and increased the opportunities for business contacts and recreation.

Cities do not exist in isolation. They are a part of the pattern of villages, towns and cities linked by transportation and communication networks, established after a century of increasing specialization in manufacturing and provision of services. Certain activities are more efficient when clustered together — most of Canada's steel is produced in Hamilton; Montreal is the centre of the clothing industry; Toronto, Montreal and now Calgary are financial centres. These places provide goods and services for the nation.

In contrast, there is no national pop-bottling or bread-baking centre. Instead they are found in most medium-sized centres. Here, we have a distinction between city-building industries that bring income into the community and city-serving industries that are found almost everywhere.

Activities such as bread-baking or pop-bottling also serve surrounding villages. In return, these rural fringes provide services to urban centres. Originally, the services were mainly the supply of food and wood. Nowadays, the countryside also provides open space for recreation; sand and gravel for construction; sites for garbage disposal, and land for urban expansion.

The Distribution and Structure of Cities

Towns and cities cover less than one percent of Canada's land area. Nevertheless, they are important users of land because they concentrate in specific areas. It is no accident that aggregations of population, industry and intensive agriculture are found where climate is favorable, the soil is most fertile, and natural transport routes exist, such as southern Ontario, southern Québec and southwest British Columbia.

Residential uses account for 55 percent of the developed areas of cities. Industry uses 15 percent, commerce 7 percent, recreation and institutions 8 percent and 15 percent for roads and parking.

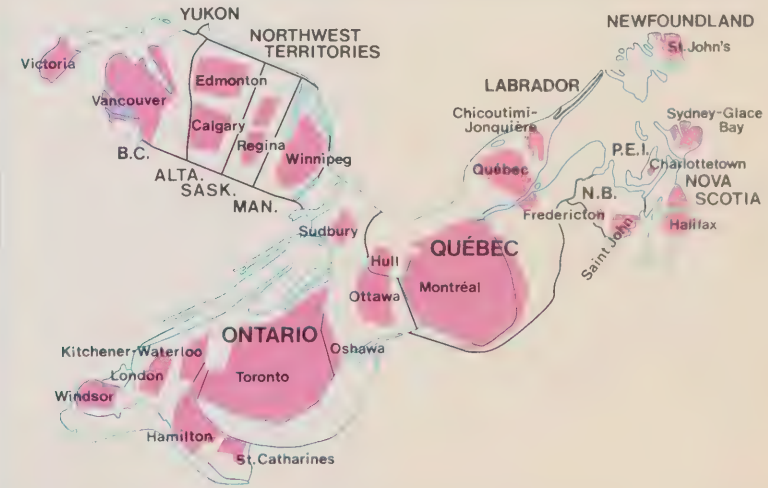
The structure of a city always reflects economic history, growth, and the physical opportunities and restrictions of land. However, some generalizations are possible. The typical city has a central business district surrounded by older housing, warehouses, parking lots and factories. More spacious residential areas are further out. Concentrations of industry are often found along a railway or arterial road. On the urban fringe, commercial strips and shopping centres line the highways while the remaining land is idle, or used for waste disposal or recreation. There are also scattered residences and hobby farms.

Question: What are the leading economic activities in your town or city?

Further reading: Ministry of State for Urban Affairs, 1976, Human Settlement in Canada, 101p.

Two views of Canada's population. At left is a conventional representation, showing how much of our land is sparsely settled. Grey represents more than one person per square kilometre. Compare this map with those of climate, soils and vegetation. At right, the Isodemographic Map shows how urbanized we are. This map, strange at first, shows cities and provinces according to their population totals, not geographical extent.

THE MAIN SETTLED AREAS OF CANADA



ISODEMOGRAPHIC MAP OF CANADA

Land Uses in Canada

The three preceding sections refer to several of man's activities on the land, namely hunting, trapping, farming, industry and commerce. There are, however, many others, such as timber or pulp production, outdoor recreation, water supply, energy production and transport. These activities are called land uses, several of which are illustrated by photos in this section.

The table lists the main land uses in Canada and the areas which they occupy. Data come from several agencies, each using different methods and dates of survey. Some figures are not available, such as the area used for commercial fishing or for hunting and fishing by natives and sportsmen. Nevertheless, the table shows how much our livelihood depends on a small percentage of Canada's area. Less than 7 percent of our land is used for agriculture, about 2 percent by commercial forest industries and only 0.17 percent for actual mining and energy production.

The total land used appears to add up to only one-third of our country, but this is still a possible exaggeration of total land use. Many uses take place on the same land, such as when hydro lines cross farms, or mineral exploration is carried out in logging areas. Furthermore, the figures represent the areas managed as part of a certain use. Thus, the agricultural figures include woodlots and idle land, and the mineral claims and permits areas include land that may have been passed over only once by a survey aircraft.

National Film Board

Urban transport, Ottawa.

Some Figures for Comparison

		Sub-total: km²	%	Total: km²	%
Canada:	total including land and freshwater, not territorial waters			9 976 140	100
	land	9 220 974	92,43		
	freshwater	755 165	7,57		
Land with Agricultural Capability Classes 1 to 4				713 650	7,15

Land Uses

Agriculture:	total including woodlots			671 682	6.73
	improved	437 074	4,38		
	unimproved	234 608	2,35		
Forestry:	private forest land tenure			199 000	1,99
	averaged annual logged area	5 500	0,06		
Parkland, reserves and wildlife protection areas:	total			964 668	9,67
	national parks	129 941	1,30		
	provincial parks	202 618	2,03		
	park reserves	64 243	0,64		
	other wildlife protection areas	567 866	5,69		
Mineral and Energy Development and Production:	total			1 069 000	10,72
	area disturbed by mining	1 285	0,01		
	hydro-electric head-ponds (reservoirs)	16 200	0,16		
	pipelines and electrical transmission	4 800	0,05		
	claims, grants, leases, exploration permits	1 046 715	10,49		
Indian Reserves				29 272	0,29
Urban Areas, including built-up, roads, parks, etc.:	total			34 000	0,34
	built-up	15 691	0,16		
Transport, including roads within urban areas, and railways and airports				37 525	0,38

A number of challenging thoughts and questions arise from the table of land uses:

— although we are a mineral and energy-rich country, mining and reservoirs use only one-sixtieth of the total area involved in mineral and energy development, and only one six-hundredth of the area of Canada.

— Canadians have allocated more land to parks and wildlife protection than they have to farming. Why is this so?

— Transportation uses twice as much land as our houses, factories, offices and other buildings combined. What do you think accounts for most of this transport land use?

National Film Board

Hydro-electric generation, Shipshaw, Quebec.

National Film Board

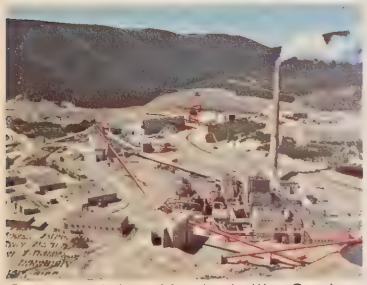
Business district and park, Calgary, Alberta.

National Film Board

Waste disposal, Hamilton, Ontario.

National Film Board

Shopping mall and housing, Edmonton, Alberta.



National Film Board

Copper mining, Murdockville, Quebec.

National Film Board

Dairy farming, British Columbia.

Attitudes to Land

The attitudes of most Canadians towards their land result from a mixture of history, tradition, personal experience, views on social justice, and views on whether land is a commodity or a resource. These attitudes, rather than the natural characteristics of the land, often determine how people use land, or how they react to proposals concerning land use.

Until this century, land ownership in much of the western world was the privilege of a select few. Many Europeans were tenants, serfs and peasant laborers. When agricultural and industrial revolutions reduced the need for cheap rural labor, many people became displaced paupers. Abundant and free land was one of the prime factors in motivating immigration to Canada. This desire to own land is deeply rooted; it often colors our attitudes to land, property rights, and our rights concerning the use of land.

The notion of freedom to use land in any way derives from our history, and the economic principles of a free market, wherein mankind is thought to be best served when all people are free to pursue their own destinies. A related attitude is that land is a commodity, something to be bought and sold like furniture or cars. Built in is the idea that owners have no obligations other than to themselves, that they need not be concerned about the state in which they leave the land for the future.

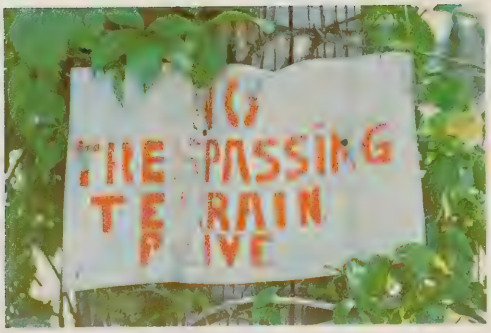
There have been many cases where profitable private acts have been costly to other sectors of society. Pollution and building on hazardous lands are two recurring examples. Other common situations arising are urban squalor and suburban sprawl; restrictions on public access to private lands of special value, such as game clubs and waterfronts, the uncontrolled disposal of raw sewage, and incompatible uses, such as farming and suburbs.

As later sections of this book show, these attitudes are slowly changing. We can and must develop an attitude of stewardship and care for our land resource. It's the only land we have.

Question: Should governments be involved, through legislation or policy, in efforts to promote land conservation similar, for example, to efforts which encourage energy conservation?

A man is nothing without land. This land is our land. Possession is nine-tenths of the law. A man's home is his castle. The territorial imperative. Get off my land! Landlord, Landed gentry, . . . for Land's sake! Our language is full of words and phrases which express the desire for land and the inalienable rights of ownership.

Photo on opposite page by David Welch


PASSING
RAIN

Land Use Conflicts

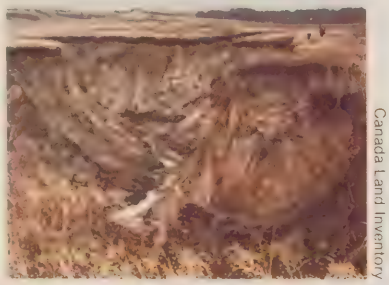
Canada is one of the world's largest countries, and yet it has relatively little land suitable for food or timber production. Because of climate, only one-twelfth of our land can be used for agriculture and of this amount, only one-twentieth is prime land. Land suitable for one use also tends to be suitable for other uses and there are conflicting demands for those small areas which are valuable for many uses.

Good agricultural land for example, is easy to build on and is often also a prime location for highways and factories. It may also be capable of producing commercial timber. These conflicts are usually resolved through market pressures, either directly through land purchases or indirectly through economic or political pressures to change land use and regulations. Without strong controls, land ownership or use usually goes to those willing to pay a high price in return for an early profit, rather than to those who would maintain or use land for its long-term potential. Housing may cover good agricultural land; highway construction may result in the filling of wetlands important for wildlife, recreation and flood control.

Conflicts often arise when certain land uses are too close to each other. Freeways make poor neighbors for housing, schools or hospitals. Farmers and suburbanites cause problems for each other because farm activities are often noisy or smelly, and city folk may ruin fences and crops, or disturb farm animals. Individually these may be small, local problems. However, the problems are common to all growing cities, and, collectively, are of country-wide significance.

David Welch

This brand-new row housing is surplus to market needs. They still await buyers after two years. Meanwhile land is irretrievably lost to other uses.



Canada Land Inventory

Improper farming methods lead to rapid erosion of fertile land.

National Film Board

Urban development on flood plains leads to personal losses and disruption of transport. Too often we all pay indirectly, through government-aided flood relief payments.

Misuse of land may lead to erosion, decline in soil fertility, or pollution of high quality forest or agricultural land. Strip mining is a concern throughout much of western Canada. In several parts of Canada, houses and factories are built on flood plains, landslide-prone areas, or other lands with a potential for natural hazard. The inappropriate use of hazard lands has and will continue to cause loss of life and property, and require expensive remedial action.

Canada Land Inventory

Dumping wrecked cars may prevent bank erosion, but it can introduce chemical pollutants and is visually degrading.

Ian Marshall

Unreclaimed mining land is also ugly and, more important, a loss to other land uses such as agriculture, urbanization, wildlife or forestry.

Geological Survey of Canada

Housing is chosen as another example of an obvious land use mistake. Individual homeowners are often the least aware of their surrounding environment and its limitations.

Question: Should we develop housing policies which cut down on disruption to natural resource production?

Further reading: Black, W.A. and D. Stewart, 1976, Land Pollution in the National Capital Region. Lands Directorate, Environment Canada, Occasional Paper No. 5, 30p.

A Land Use Conflict: Rural to Urban Land Use Conversion

Canada is becoming more urbanized. Each year more people move to urban areas, our cities grow. In 1966, 12.3 million Canadians lived in towns or cities of more than 25,000 people. By 1971, the number was 13.5 million, a rise of 10 percent. By the mid 1970s, 76 percent lived in cities, compared to 35 percent in 1901. The accompanying graph shows that during the last 100 years, our rural population has been relatively stable; most population growth has been absorbed by towns and cities. Even the rural areas are affected by urban growth, as more and more Canadians commute to cities from country homes or outlying villages.

The large cities are growing the fastest yet these large centres are also more efficient in their urbanization. Low-density, urban-fringe developments are around all cities, but the tendency towards high-rise development in existing built-up areas is greater in a large metropolis.

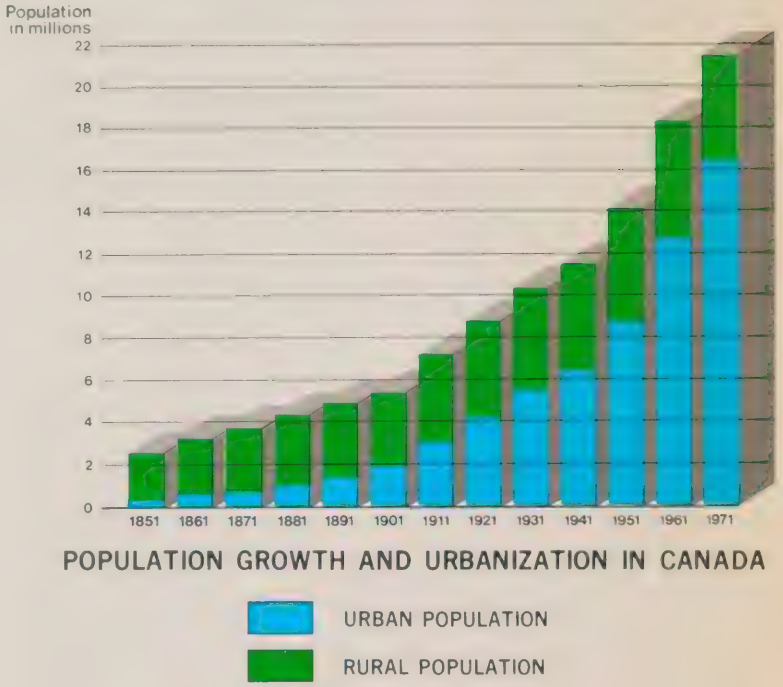
Because most cities have developed as a result of agricultural wealth, they tend to be located amidst good land. In fact, more than half our prime agricultural land lies within 80 kilometres of cities of 100,000 people or more. This same land produces more than two-fifths of the total value of farm products.

Urban pressures, however, create problems for the farm economy. Each year construction removes about 17 000 hectares of agricultural land from gainful use. Twice this amount, it is felt, becomes idle because of urban pressures such as zoning changes and increased taxes, conflicts between farming and recreation, subdivision of land holdings, speculation and trespass by urban dwellers.

In southern Ontario and southern British Columbia, from the point of view of soil and climate, the growth of cities is taking place on land of special value to Canada's vegetable, fruit and wine industries. From 1966 to 1971, for example, more than 13 000 hectares of farm land were lost to Toronto, St. Catharines, Hamilton and Chilliwack. Urban expansion however, consumes more than agricultural land. During the same period Edmonton built on 930 hectares of prime waterfowl habitat while Montreal, Toronto, Kitchener and London expanded and took 4 400 hectares of good forest land.

Some cities, such as London, Winnipeg and Toronto, are surrounded almost entirely by prime agricultural land. These cities might be able to absorb future growth by increasing housing densities but other cities, such as Vancouver, Quebec, Halifax and Ottawa, have many types of land nearby and can expand onto less productive land. British Columbia has already taken steps to protect high quality agricultural land by establishing Agricultural Land Reserves to protect prime agricultural land from urbanization. Québec has adopted comparable legislation, and Newfoundland is considering similar restrictions.

The misuse of high quality land is a loss for all Canadians, because the same kind of production cannot be carried out elsewhere. Either we must curb the loss of prime food land, or rely more on imports in the future.



POPULATION GROWTH AND URBANIZATION IN CANADA

Question: Should we, as Canadians, be prepared to accept smaller or more expensive housing as a cost of protecting land with a high capability for producing food, wood, wildlife, etc.?

Further reading: Gierman, D.M., 1977, Rural to Urban Land Conversion. Lands Directorate, Environment Canada, Occasional Paper No. 16, 74p.

Neimanis, V.P., 1979. Canada's Cities and their Surounding Land Resource. Lands Directorate, Environment Canada, Canada Land Inventory Report No. 15, 80p.

A Land Use Conflict: The Peace-Athabasca Delta

THE PEACE-ATHABASCA DELTA

At the western end of Lake Athabasca is a delta consisting of many lakes. This delta is important for goldeye, muskrat and bison, and is a nesting and staging ground for waterfowl. Five thousand Cree, Chipeweyan and Metis depend upon this land and its resources for their livelihood. For centuries the lakes and ponds of the delta have been sustained by summer flooding resulting from high spring flows into Lake Athabasca. High water levels on the Peace River also limited outflow. The repeated flooding maintained the delta and a delicate environmental balance was established among plants, animals and people.

Late in 1966, however, B.C. Hydro began filling the reservoir behind the Bennett Dam on the Peace River in British Columbia. This filling, which took four years, reduced flow downstream and the result was lower water levels in Lake Athabasca and its delta. The traditional summer floods and replenishment of lakes and ponds no longer occurred.

These changes, resulting from actions taken 650 kilometres away in another province, soon led to critical changes in the delta. By 1970, vast mud flats were exposed, and many ponds were dying out. Habitat was lost for migratory birds and muskrat. Bullrush and sedge, the main food for

The W.A.C. Bennett Dam.

geese, gave way to willows. It became clear to inhabitants, scientists and resource managers that unless remedial steps were taken quickly, there would be serious, permanent damage to wildlife and the local economy.

A joint Canada-Alberta-Saskatchewan task force recommended construction of a small dam and weirs on streams flowing from the delta to Peace River. These structures restored water levels, and delayed the release of spring floods, so that conditions were almost the same as before regulation of Peace River. In order to measure the effectiveness of these plans various federal and provincial agencies are monitoring bison, waterfowl, furbearers, fish, vegetation and water levels and flows.

The recent history of the Peace-Athabasca Delta shows us the interrelations among man, land and natural resources, not only at one point but at places hundreds of kilometres away. When a resource is developed without thought for all possible side-effects, then serious damage may be done not only to nature but to people, economy and lifestyles. Effects could be felt in metropolitan areas as easily as in small, remote communities. Success of the remedial measures in the Peace River - Athabasca area has not yet been fully evaluated. In the future we must consider all consequences

Mudflats exposed by low water on the Peace-Athabasca Delta.

of a land or resource development before development begins. It is only then that options of location, scale and design are still open.

Question: What are some of the potential environmental results of

a) forestry clear-cutting?
b) oil sands development?

Further reading: The above text is a condensed version of that appearing in — Fisheries and Environment Canada, 1976, The Canada Water Year Book. Supply and Services Canada, 106p.

Land for the Future

So far, we have looked at patterns of nature and man in Canada. We have seen the interdependence of nature, how man depends upon the land and the land-related problems of modern man, many of which revolve around our increasingly-urban lifestyle. In fairness to mankind, our ancestors were in some cases no better. Witness the smog in industrial areas in the 19th and early 20th century; the extinction of the carrier pigeon, and the loss of public access to shoreland. Since the 1960s, however, there has been a growing feeling that there is a "last chance" to keep our world hospitable. For many people, this feeling reached its climax when Apollo astronauts looked back on our "spaceship Earth". We became graphically aware of the confinement of our living space.

These concerns for the environment, its resources and our future, rest upon three considerations:

— Our planet, each country, and each province and each resource has definite limits.

— World population and through migration, regional urban populations, are rapidly increasing.

— Each person expects a continued rise in the standard of living.

The basic needs of people are air, water, food, shelter and clothing, in that order. Water and food require land on which to collect and grow. Land is needed for shelter, to produce the brick, stone or wood to build our homes and to provide the space on which to construct them. Many textiles are derived from plant fibres. Land is therefore a critical resource needed for its soils, waters, plants and animals and, quite simply, its space. This book is directed at this need, the wise use of the land resource.

We have discussed many types of land-related problems. Resolution of such problems requires two strategies. The first is to develop a set of new attitudes towards land, and the second is to become more aware of the natural properties of land.

In developing new attitudes, we must begin to see ourselves as a part of the environment. Everything we do puts stress upon this environment; we must see that the stresses are within safe limits. We should be stewards of the land, not only consumers of its stored wealth. Space must be used efficiently so that multiple and compatible uses are developed and conflicting ones avoided. Impacts upon the environment must be minimal.

To achieve these goals, more than a change of attitude is required. Information about the land, its capabilities, its limitations and its special features is needed. These data must be made available to, and used by, politicians and planners at federal, provincial, regional and municipal decision-making levels. Individuals are also both planners and decision-makers. When we build or buy any type of housing, farm, or cottage we can make better judgments if we know the type of land we are buying or developing, and what it can do for us or to us. The following pages offer some sources of land information, all of which are available to the general public.

National Film Board

Question: It has been asked "Why should we care about the future? What has it ever done for us?" We should now ask "We care about our children: what can we do for them?"

Further reading: Beaubien. C. and R. Tabacnik, 1977, People and Agricultural Land. Science Council of Canada, 137p.

Land Information

Knowledge is power — the power to achieve a desired goal. Our goals should be to make the best possible use of resources, minimize the impact of our activities on the environment and retain a harmonious balance in man's living space. Resources mean more than oil, wood and water. Soil for crops, animals, space for recreation and clean air for breathing are all of equal importance to our everyday well-being. Sound management of land resources is essential if we are to continue to provide for our basic needs.

The knowledge we need for sound land-use planning involves many resources, not only non-renewable ones, such as coal, but also renewable resources, such as trees. We need to know more about our resources — quantity, location and quality. How fast do they renew? What is the maximum harvest in order to ensure replenishment? What should be the harvesting method? We should also be able to predict the consequences of our actions. Will soil erosion result? Will the excavation of a quarry lower the groundwater level below the reach of surrounding wells? Will waste discharge overtax nature's cleansing ability? What special features of the land should be avoided or protected? Where are the landslide-prone areas? What are the flood hazards? Where are the hailstorm tracks? Are there any special wildlife habitats, or sites of outstanding natural beauty? Does a piece of land have cultural or historical significance? What is the present land use? How many people depend on the present land use for their livelihood?

Answers to these questions require knowledge of the environment, resources and economy of an area. The range of questions shows that gathering this information can be complex, requiring a multi-disciplinary approach. Each discipline has its speciality, and each may measure a number of properties. For example, biology includes forestry, zoology, agrology and botany. Forestry, in turn, deals with species, tree cover and standing crop, plant succession and regeneration rates.

With all this potential information, we could be swamped by masses of data, unable to see the forest for the trees! Fortunately, general concerns require general data. Federal, provincial and regional interests can be served by basic data dealing with selected aspects of the environment. We do not need a detailed inventory of the whole country. Conversely, as planning and management focus on specifics, then more details are required. We must, however, guard against using general records to resolve local land-use problems.

Individuals rarely need to collect this sort of information for themselves. Common sense helps, simply by looking at and thinking about a piece of land. Other printed information is available. Reports and maps on geology, soils and forestry, for example, are available from various federal and provincial agencies, or through bookstores which sell government publications. A number of information sources are described in the following pages.

Question: What environmental factors should you look for in buying a house or land?

Further reading: Simpson-Lewis, W., J.E. Moore, N.J. Pocock, M.C. Taylor and H. Swan, 1979, Canada's Special Resource Lands: A National Perspective of Selected Land Uses. Supply and Services Canada, 232p.

The Canada Land Inventory

The Canada Land Inventory is a survey of land capability and use across the nation. The inventory provides a basis for regional resources and land use planning and includes evaluations of land capability for agriculture, forestry, recreation and wildlife, as well as land use up to the late 1960s. The Canada Land Inventory is a joint federal-provincial program, the largest land survey of its type ever undertaken in the world.

In the early 1960s, there was competition for land for alternate uses, and increased government economic and social planning in rural areas. It became apparent that there was a need for improved knowledge of the location, extent and productive capability of Canada's lands. However, since land use conflicts were not as critical in remote areas, only areas of significant agricultural potential were included in the inventory.

Themes

The inventory consists of more than 15 000 manuscript maps depicting land capability and use. Several factors are rated, with Class 1 being the best land and, in most instances, Class 7 being the poorest. The information is published using various scales, the main one being two and one-half kilometres to the centimetre. Units of land are color-coded according to their capability. Letter symbols indicate the main limiting factors for the particular theme.

(1) Soil Capability for Agriculture. Soils are rated on general suitability for production of common field crops. Subclasses indicate limiting factors such as aridity (dryness), stoniness, fertility and inundation (flooding).

(2) Land Capability for Forestry. Soils are rated according to ability to grow commercial timber. Each class expresses a range of productivity based upon mean annual increment of the species best adapted to the site. Subclasses indicate limitations to forest growth, such as aridity, soil moisture excess, or excessive levels of toxic substances.

(3) Land Capability for Outdoor Recreation. Sites are rated on ability to generate and sustain outdoor recreation, with some consideration for any national significant or unique features. Other themes record limitations but recreation subclasses show features which provide opportunities. Examples are shoreland suited to family beach activities, waterfalls or rapids, interesting rock formations, and major man-made structures.

(4) Land Capability for Wildlife. All species require food, protective cover, and space to survive, grow and reproduce. Despite these basic needs of all wildlife, the inventory recognizes three main types, each of interest to man and each with a particular set of habitat preferences. A map series is produced for ungulates and waterfowl and, in most provinces, one is being produced for sportfish.

For ungulates, such as deer and moose, there are seven classes, based upon the abundance of food plants and other habitat elements. Three special classes describe the capability of land for winter ranges. Subclasses describe limitations in food and cover plants.

For waterfowl, such as ducks and geese, there are also seven classes, describing the capability of land and water in providing necessary food and habitat. Four more classes rate migration stops and wintering areas. Subclasses denote limiting factors which affect either waterfowl or the ability of the land to produce suitable habitats.

Four classes indicate the capability of water to support sportfish. Subclasses indicate limitations such as low discharge, lack of nutrients, or temperature extremes.

(5) Land Use. The Census of Canada, air photographs, assessment rolls, and other sources were used to map present land use, dated to about 1967. Only a few sample maps, generalized to 1:250 000, are published.

THE CANADA LAND INVENTORY AREA

How does the CLI affect you?

The Canada Land Inventory maps for agriculture can be used to locate lands with a high potential to produce food. These are lands which should be preserved for continuing agricultural use. The maps enabled the British Columbia Land Commission to designate Agricultural Land Reserves. The areas chosen were defined primarily by CLI agriculture classes 1 to 4. Other provinces, such as Québec, Newfoundland and Prince Edward Island used or are using the Canada Land Inventory to set land use policy.

The Canada Land Inventory has also been used to identify potential parks and marginal farmland for rehabilitation. It is increasingly likely that the lives of rural and urban fringe residents will be touched by planning decisions based on CLI data.

The maps may also be useful to individuals, looking for such things as cottage sites or hobby farms. Because the published maps are generalized to 1:250 000, they may not reflect the character of an individual lot, but can be used to locate areas which have a significant proportion of land highly suited to a particular purpose. Further searching can then be directed to those areas.

Question: Considering such aspects as engineering, scenic beauty, environmental impacts and hazards, what factors would you use in assessing land capability for housing?

Further information: Lands Directorate, Environment Canada, A Guide for Resource Planning: The Canada Land Inventory. This is a pamphlet which summarizes the Canada Land Inventory. For this or for index maps, please write to — Canada Land Inventory, Lands Directorate, Environment Canada, Ottawa, K1A 0E7, Canada.

Canada Land Inventory

The photo illustrates the accompanying portion of the CLI Outdoor Recreation Potential map for the west side of Newfoundland. The field of view of the photo is indicated on the map. Classes 3, 5 and 6 are evaluations of overall recreation potential on a scale of 1–7. Subscripts are as follows:

A — Access to water with opportunities for angling.

B — Shoreland with opportunities for beach activities

E — Outstanding, attractive or unique vegetation

P — Diverse pattern of cultural landscapes.

Q — Diverse topography

R — Rock formations

V — Good viewing opportunities

Other subscripts shown on the map are explained on the published map and in CLI reports.

Ecological Land Survey

Since the early 1960s, much expertise in land resource survey has developed in Canada. Initially this expertise centred around the Canada Land Inventory. In the late 1960s and early 1970s, however, many planners, resource managers and scientists felt land survey should be extended to remote areas, and at the same time, to describe the land, rather than make a limited number of interpretations. This way, each user could make his own interpretation to suit his own use and not be confined to a limited set of assessments.

These needs are met by an ecological land survey which combines many disciplines to describe land resources. Such integration avoids costly separate surveys. More importantly, it is relevant to planning and impact studies as it avoids complicated, overlapping map units. Instead it portrays ecosystems — units of land having distinct properties and processes.

Ecological land survey is hierarchic; it perceives ecosystems at various levels, large units consisting of several smaller ones, and so on. This multi-level approach is important, since many of today's planning needs are adequately met by low cost, general data for large areas. Specific projects, such as parks, resorts, dams, mines and factories, require more details. This can be provided by "filling in" the regional information, still using ecological land survey methods.

Ecological land survey has been used for a large number of surveys, conducted by many agencies, ranging from consultants and universities to provincial and federal governments.

Further reading: Canada Committee on Ecological Land Classification, 1979, Applications of Ecological Land Classification in Canada. Ed. by C. Rubec, Supply and Services Canada, 396p.

Ed Wiken

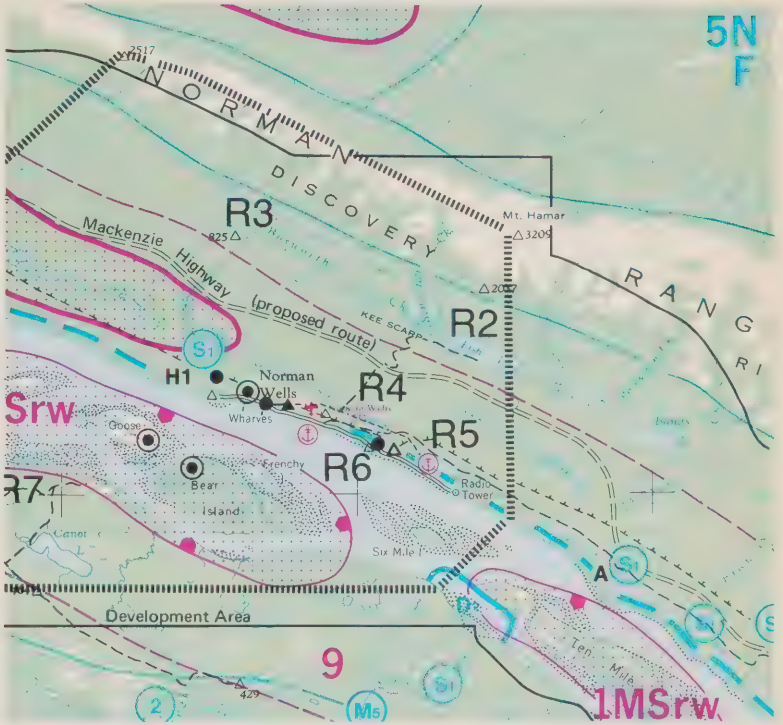
Ed Wiken

Ed Wiken

These three photos from British Columbia show the telescoping view of land that can be mapped, classified and evaluated by Ecological Land Survey. For landforms, as an example, we could characterize the area by describing its mountain range (left), individual mountains (center), or individual plateaux, slopes and peaks (right). Similarly, soil, vegetation, water and wildlife habitat can be described at various levels.

Northern Land Use Information

In 1972, the federal departments of Environment and Indian and Northern Affairs began producing a series of Land Use Information Maps for the Yukon and Northwest Territories. These atlas-style maps presented an overview of resources and management concerns, including descriptions of critical or important areas for wildlife and fish, native land use, a recreation-terrain analysis, and supplementary physical, climatic, economic and social data. Extensive notes on the margin of each map provided details and background information. As of 1979, there were 188 published maps covering all the Yukon and half the Northwest Territories, a total area greater than that of the three prairie provinces.



A portion of a Northern Land Use map. Superimposed on a 1:250 000 topographic map are blue, black, red and grey symbols marking areas of wildlife interest, hunting, mineral leases and other land uses.

Further information: for more details, please write to — Northern Land Use Information, Lands Directorate, Environment Canada, Ottawa, K1A 0E7.

Other Land Information

Land information is available from other sources as well. Geology, soils and forestry data exist in both map and report forms. Stream flow and water quality, weather and climate, and wildlife information are available through numerical data, graphs, tables as well as in reports. Information is available from both federal and provincial agencies dealing with these topics.

Land Information in Use: the James Bay territory

The James Bay territory is a land of boreal and tundra vegetation, a northern climate, with hills, lakes and rocky streams characteristic of the Canadian Shield. Forestry and agriculture are not developed here and the land is sparsely settled. In 1972, however, 410 000 square kilometres of the region were set aside for hydroelectric development. The James Bay Development Corporation was established to assume responsibility for all aspects of resource development and management in the territory.

Since then, the James Bay territory has witnessed many developments — dams, reservoirs, generating stations, drainage diversions, airports and landing strips, permanent towns and temporary work camps, roads and power transmission corridors. It was recognized early in this development that to lessen the environmental impacts, to find suitable sites for roads and settlements, and to benefit from resource opportunities in hitherto inaccessible areas, the entire territory needed long-term, integrated ecological planning and management.

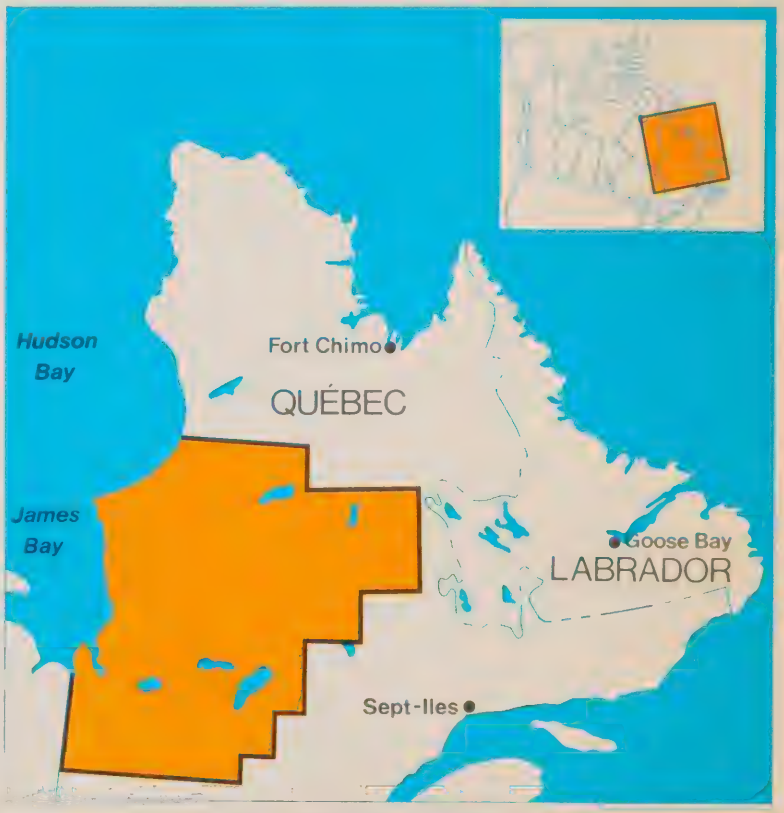
To provide land resource information for this planning, Environment Canada and James Bay Development Corporation agreed to sponsor, among other environmental studies, an ecological land survey of the entire territory. A team of 29 scientists has since surveyed the natural resources of the area, producing 123 maps (at a scale of one and one-quarter kilometres to the centimetre). The maps show units of land, each describing the main biological and physical characteristics, such as soil development, vegetation succession, relief and water bodies.

The information for each map has been interpreted many ways, including land capability for growth and regeneration of various species, the ability of the land and water to support various animals such as moose, beaver, muskrat and waterfowl, opportunities for aquatic recreation, and appreciation of natural beauty. These and other interpretations have been used to compare the potential productivity of various resources in an area, to locate exceptional scenic and historical landscapes, to select ecological reserves, and to predict environmental problems, such as the risk of erosion due to heavy vehicle movements, or the potential for shoreline erosion on lakes subject to water level control by dams.

Reference: Ducruc, J.P., 1979, Major Applications of Ecological Land Inventory and Classification in Quebec, p. 193-199 in Can. Comm. on Ecological Land Classification, 1979, Applications of Ecological Land Classification in Canada. Ed. by C. Rubec, Supply and Services Canada, 396p.

Societe d'energie de la Baie James

Electricity transmission line, James Bay territory, Quebec.



THE JAMES BAY TERRITORY

Land Information in Use: the MacKenzie Valley

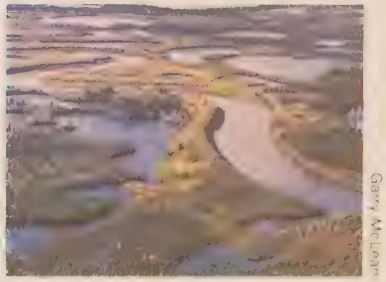
During the 1960s and 1970s, resource exploration and development in northern Canada increased at a sometimes frenzied pace. The discovery of oil and gas in northern Alaska and subsequent drilling programs in the Mackenzie Delta focussed Canadian attention on proposals for oil or gas pipelines from the Arctic coast to markets in the south. Proposals for such large-scale developments were subject to public scrutiny as never before. In response to this public concern for the environment and recognizing the need for baseline environmental data, the federal government instituted several programs and procedures to thoroughly assess the impact of large resource developments. The multi-million dollar Environmental-Social Program is one example of such a program, designed to support an assessment process. In co-operation with private industry and co-ordinated by the program staff, a number of government departments began a series of three-year field research programs in the physical, social and environmental sciences. All studies focussed on the pipeline corridor, extending from the Alberta border along the Mackenzie Valley to the Mackenzie Delta, and then west to Alaska. By 1974, the results of these special studies were available to the public in more than 200 reports and papers.

The Environmental-Social Program research prepared the way for a series of assessments the best-known of which was the Berger Inquiry. Judge Berger was appointed in 1974 to consider the social, environmental and economic factors of a gas pipeline and energy corridor along the Mackenzie Valley. The inquiry received nation-wide recognition for its extensive hearings, formal and informal, in large and small communities across Canada. As never before, the Canadian public became aware of the complexity of issues that must be examined in any assessment of a large-scale project. Throughout the inquiry, baseline environmental data, such as that developed under the Environmental-Social Program, formed a solid background for many of the inquiry's submissions.

THE MACKENZIE RIVER STUDY AREA

The detailed environmental research, conducted to support the pipeline assessment, pointed out a number of critical areas of national concern. Judge Berger's final recommendation not to build a pipeline across the northern Yukon was based on environmental issues, as were numerous recommendations for other routes. His recommendations and the subsequent decision by the National Energy Board to reject a Mackenzie Valley Pipeline illustrates how, in today's world, environmental and social research can affect the decision-making process and drastically alter the destiny of large parts of Canada.

Drill site north of Inuvik.



The MacKenzie Delta.

Reference: Berger, the Hon. Mr. Justice T.R., 1977, Northern Frontier, Northern Homeland, The Report of the Mackenzie Valley Pipeline Inquiry. 2 vols. Supply and Services Canada.

Land Information in Use: Environmental Impact Assessment

In response to public concerns about environmental affairs and the potential for man-made disasters, the post of Minister of the Environment was established in 1970. One of the main concerns of the minister is to examine the federal government's role as a polluter, and to make certain that suitable measures are taken to prevent or reduce such pollution and other problems in the environment. Examples of the latter include physical impediments to aquatic life and wildlife migration routes, and the indiscriminate use of resources.

To fill this role, the Environmental Assessment and Review Process was established. Under this process, all federal projects, programs and activities are required to take environmental effects into account in their planning, to assess adverse effects before irrevocable actions are taken, and to use this knowledge in federal projects. Federal projects are those started by federal departments and agencies, as well as those involving federal funds or property. The ultimate responsibility for final decisions based upon the hearings rests with the Environment minister and Cabinet colleagues.

The Environmental Assessment and Review Process is based on the self-assessment approach. The significance of potential adverse effects depends initially on the judgement of technical and environmental specialists. Federal departments and agencies then assess environmental consequences of their own projects, or those which they sponsor, and decide upon the environmental significance of these anticipated effects. In cases where these effects are adverse or unkown, an Environmental Assessment Panel is established, usually made up of four to six experts who review the environmental consequences. The department or agency responsible for the project is required to submit an Environmental Impact Statement detailing expected environmental consequences of a project. The nature of the project and its proposed location will determine, in many respects, the type of information required. For example, the impact of noise and of a new use for land would be prime considerations when assessing a proposal for a new airport. Potential damage from radiation would be an important factor in reviewing a proposal for a nuclear generating station.

A project submitted for panel review may not be carried out until the panel holds public hearings, weighs public reaction against scientific and technical aspects, and decides upon its recommendations. The ministers of the department involved and the department of the environment then decide whether or not the project should proceed, and may recommend further modifications and safeguards.

As a result of the Environmental Assessment and Review Process, many federal projects have already been modified in the planning phases to avoid or remedy potential environmental problems. A few projects have been subjected to the entire process, including the paving of the Alaska Highway, and the proposed Eldorado Uranium Refinery.

This approach to environmental decision-making among federal departments and agencies is not prescribed by law. Rather, it is a commitment by federal ministers, through Cabinet decision. The degree to which participants in the process accept their responsibilities, and the quality of the decisions which result, will determine whether or not the objectives set for the Environmental Assessment and Review Process are achieved.

Further reading: The above text is based largely on — Environment Canada, 1977, A Guide to the Federal Environmental Assessment and Review Process.

Solutions

So far this booklet has looked at examples of land resource conflicts and problems, at land information sources necessary for resource-based planning, and at a few examples of how such information has been used. The following pages list ways in which governments and people can act to incorporate these principles into environmentally-sound land use planning.

Solutions for Governments

Land Use Policy

provincial
federal

The federal government and many provinces are developing land-use policies which encourage regulation of certain land uses and contribute to preserving the best resource lands for uses most desired in the long run by Canadians.

Land Use Control

municipal
regional
provincial

The zoning of land and the use of special taxes or subsidies are now used in much of Canada. In British Columbia, Agricultural Land Reserves have been created to keep the best food land for future agricultural use. Ontario has developed a special tax incentive for famers intended to keep the best farmland in production. Prince Edward Island has limited land acquisition by non-residents. Other methods, such as local zoning and farm subsidies, are used in various parts of Canada. All are designed to encourage the wise use of our land.

Public Acquisition of Special Lands

municipal
regional
provincial
federal

Across the nation there has been public acquisition of lands of particular value to Canadians. The creation of national and provincial parks, historical sites, and wildlife, forest and ecological reserves are all ways to protect lands critical to Canada for social, economic or scientific reasons.

Resource Surveys and Monitoring

provincial
federal

Provincial and federal governments collect data in order to learn as much as possible about the quality, extent and location of various types of land. These surveys involve mapping, as in ecological land surveys or the Northern Land Use Information Series. Some projects survey hazards such as forest fire danger or flood risk.

Ecological Land Use Planning

municipal
regional
provincial
federal

As we learn more about the ecological, human and economic factors which influence the use of land, the art of planning advances. A new approach, encouraged in both urban and rural areas, involves a thorough, integrated look at all environmental, social and economic implications of proposals before decisions are taken.

Further reading: Canada Committee on Ecological Land Classification, 1977, Ecological Land Classification in Urban Areas. Ed. by E.B. Wiken and G.R. Ironside. Supply and Services Canada, 167p.

Manning, E.W. and S.E. Eddy, 1978, The Agricultural Land Reserves of British Columbia: an Impact Analysis. Supply and Services Canada, 165p.

Solutions for People

Awareness

Research is always being conducted on the relationships between ourselves and our environment, our desires and requirements from the environment. Developed societies are coming to understand that we are an integral part of our world, and that we cannot conduct our affairs without that realization. People are changing their attitudes to their environment and their lifestyles; concerns over energy and resource conservation are now widely expressed.

Involvement

Public involvement is the key. There is much that one can do to help maintain the land. For instance:

(1) Home Buying. The kind of home, the amount of land, or the manner in which the building conserves or uses energy is important. Is your house or cottage located on a floodplain? Is your town expanding onto prime farmland when less productive land can be used? You can encourage the preservation of productive land by buying or building in other areas.

(2) Land Ownership. Whether or not to buy a hobby farm or a cottage can be a critical choice. If you own land already you must decide how it should be used. When large numbers of people make these decisions they help determine the future use of Canada's land. If you do own good farmland, try to use it for maximum productivity. You may be able to lease land you don't use to a farmer who will use and maintain it.

(3) Local Politics. Participate in local decisions and try to influence the people who decide where freeways, subdivisions, etc. will go. Local participation can convince politicians to examine alternatives and make environmentally-sound decisions.

(4) Wise Resource Use. Wise energy or other resource use eventually leads to less land used in the production, processing and transportation of the resource.

(5) Conservation. You can conserve and recycle. When you use a resource product, ensure that it is used properly. Cut down on waste.

Further information: Environment Canada, 1978, Environment Source Book. Supply and Services Canada, 115p.

National Film Board

Greenbelts and idle land can also produce food for fun or profit.

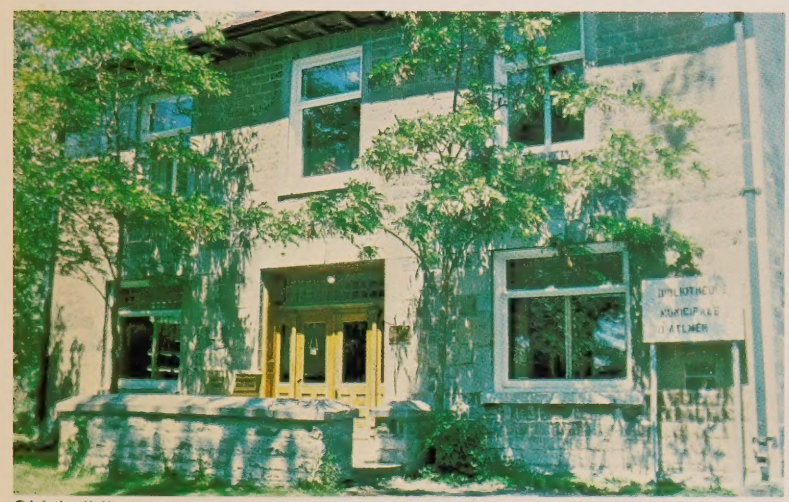
Good Land Sense

The second and third sections of this booklet show how a land sense, or land ethic, is coming into use at national, provincial, regional and municipal levels of planning and development.

A common-sense approach is also needed at the property level, in the design of buildings, landscaping, reclamation, pollution-free buildings, and urban design for a pleasing daily environment. This and the preceding page give examples of good land sense. By applying this common sense when you buy land, build an extension, vote on a by-law, or use a park, you help to create a better environment for future Canadians.

David Welch

Better than building on flood plains, this waterfront is used for recreation and public access to water. For this kind of land use, flood damages are minimal. Aylmer, Quebec.



David Welch

Old buildings can be recycled into new uses, thus preserving our heritage and, often, money.

Ian Marshall

This land near Sudbury, Ontario was reclaimed from mining. The result is more pleasing visually. It also controls runoff and erosion, improves water quality, and can be used for recreation, wildlife, forestry or agriculture.

Toward a New Land Sense

The Land has no secrets,
Its voice speaks to those who care.
Its wealth is shared by all.
And yet anarchy is never there.

Man seeks the benefit of self,
And claims the land
Without regard for its inhabitants.
For Land's sake, should not we,
Become the earth's custodians?

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